

ART. XI.—*Subdivision of the Spinal Canal in the Lumbar Region of Chick Embryos.*

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(With Plate XLII.)

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While examining serial sections of a chick embryo of about fifty-two hours' incubation, it was noticed that at the posterior end of the cord, in what would be the lumbar region of the adult, the central canal of the spinal cord was distinctly subdivided. At first this was regarded as an individual abnormality, but since then a large number of specimens have been examined, and the division has been found to occur invariably at a certain stage in the development of the embryo.

All the specimens were preserved in picro-sulphuric acid, subsequently stained with acetic acid, alum and carmine, and cut serially. The eggs used for incubation were procured from a number of different hens, and were incubated and examined during the springtime of three successive years, so that there is no reason to doubt that the development is normal.

Previous observers have described multiple canals and branchings of the central canal of the spinal cord in the chick (see Bibliography), but these are evidently different in nature from those now dealt with. In all cases they have been regarded as individual abnormalities and not, as certainly appears to be the case, as indicating a normal stage in the development of the spinal cord.

Then again, they occur at a much later date, when those now dealt with have completely disappeared. Miss A. Smith (1899), for example, describes them in a chick of 10 days' incubation, and as occurring far forward at the level of the heart and lungs. Federow (1907) describes them in a 5-6 days' chick.

In all those that I have examined, the maximum development occurs between the fifty-second and fifty-sixth hours. The period of subdivision extends from 48 to 58 hours' incubation.

Up to 42 hours the cord is unclosed and normal. At 44 hours, though the cord is closed in the lumbar region, there is no sign of any unusual development. At 48 hours the first sign of subdivision is seen in the form of a marked thickening and projection inwards of the wall on one side of the cord, the cavity, however, not being completely subdivided, although somewhat reduced.

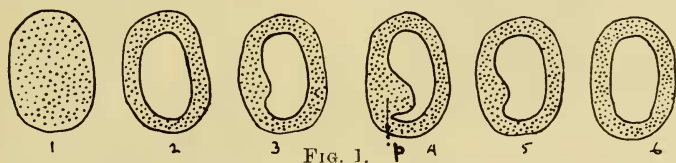


FIG. 1.

Text figure I. represents diagrammatically five consecutive transverse sections of the cord at 48 hours' incubation. The projection (p) into the central canal (c) is well shown.

At 50 hours two distinct cavities are present, as seen in the figures. The projection may be seen to have grown completely across the cord in this region in such a way as to divide off the

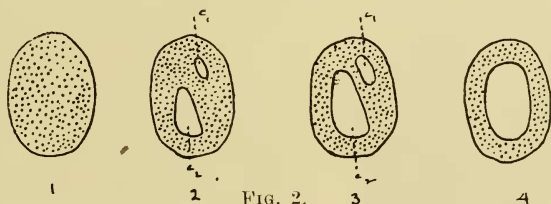


FIG. 2.

single central canal into two unequally-sized canals,  $c_1$  and  $c_2$  (see text fig. II., 2 and 3); this inequality of the resulting canals having been already suggested in the earlier stage by the peculiar shape of the internal projection of the wall of the cord. The total absence of any canal at the most posterior end of the cord is shown in section 1, fig. II.

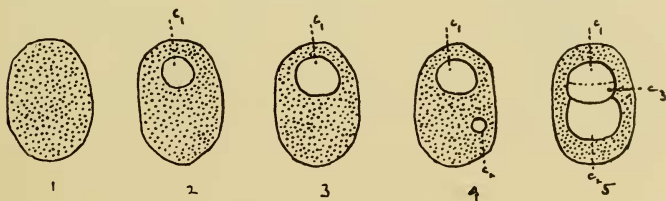


FIG. 3.

A little later, 51-52 hours, the two canals have become smaller though still unequal in size, as seen in text fig. III., 2, 3 and 4. The larger of the two ( $c_1$ ) extends distinctly further back than the other, diminishing in size as it does so. At the extreme anterior end of this subdivision the septum between these two canal ( $c_1$  and  $c_2$ ) becomes very thin, and just at this part the larger canal (cf. plate XLII., fig. 3, and text fig. III., 5) shows a distinct though very thin septum, resulting in an incipient division into three canals.

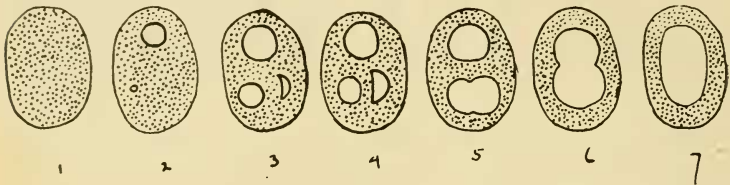


FIG. 4.

The complete division posteriorly of the central canal into three canals, as met with at 52-56 hours, is illustrated in text fig. IV. The inequality in transverse diameter and also in the longitudinal extension of the three canals is clearly seen. In most of the specimens examined three canals were distinctly visible: in several there were four, and in one instance an indication of a fifth canal was present.

The maximum extension of this subdivision is on an average 0.126 mm. in specimens of 52-56 hours' incubation. As might be expected, the lining of the several subsidiary canals is ependyma of precisely the same structure as the lining of the central canal proper.

The curious shape of the internal septa subdividing the central canal is clearly shown in sagittal section in Plate XLII., Figures 4 and 5, taken approximately at 56 hours' incubation, at which stage three canals are present. It will be seen, further, that the presence of these canals and the development of their divisional walls alter considerably the external configuration of the cord at the posterior end, causing it to become very much swollen, and often being constricted off from the general central canal.

I have not been able to determine exactly what happens to the spaces or the manner in which they close up, but this must

